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Regulated Drug Pricing and Hospital Efficiency in Japan

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Regulated Drug Pricing and Hospital Efficiency in Japan

Abstract

Japanese regulated pricing of prescription drugs influences drug utilization by physicians and pharmacists in hospitals, which in turn makes the amount spent on prescription drugs a major factor in the increasing medical expenditures in this county. This paper sheds light on how these two factors – the regulated pricing system and the low rate of separation – contribute to hospital inefficiency. It further argues for a capitation on government regulated reimbursement prices for prescription drugs in order to reduce the prescription drug overuse, and for furthering the separation policy in order to increase hospital production efficiency. The empirical results of this study not only show that the regulated pricing causes the biased allocation of resources, which contributes to inefficiency, and that the number of prescriptions exceeding the optimal level, which results in the inefficiency of hospital production output, but also shows that overprescribing drugs increases the existing inefficiencies in hospitals. Simple price reduction of prescription drugs has little impact on discouraging physicians from over prescribing drugs due to the existing negative elasticity between treatment days and drug prices as well as between the relationship of units of service and drug prices. Furthermore, the regulated pricing system also contributes to inefficient human resource allocation in hospitals, particularly pharmacist over employment, which in turn contributes to lower efficiency in general hospitals. As a means of comparative study, this paper highlights and evaluates the effectiveness of the capitation scheme in curbing medical expenditures with respect to prescription drug usage. This comparison shows that hospitals, which choose the capitation method, are less likely to emphasize pharmacists, physicians, and prescribing drugs, but are more likely to emphasize having more registered nurses, than hospitals with the cost-based fee-for-service scheme.

Keywords:

Drug utilization, Hospital efficiency, Regulatory price, Government intervention, National health insurance

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INTRODUCTION

Three are three major characteristics of the Japanese National Health Insurance. First, nearly all people are covered by some health insurance in the National Health Insurance System. Second, nearly all prices of medical practices and prescription drugs at hospitals and clinics are regulated by the government and the regulated prices are set uniformly for the whole country. Third, the National Health Insurance System follows the cost-based fee-for-service (FFS) reimbursement system. This so-called "national all-coverage insurance scheme" shapes the Japanese medical expenditures to be characterized as follows: first, per capita expenditure on prescription drugs is higher in Japan than in other industrialized nations. For example, the ratio of prescription drugs to total medical expenditures in Japan is approximately 22%, whereas the value in US is about 10%.[1] Second, the expenditures on medication and injection per episode of illness of elderly outpatients account for nearly half of the total medical expenditures on them.[2]

In response to their high proportion of medication and injection costs and the increasing trend in medical expenditures, the Ministry of Health, Labor, and Welfare (MHLW) in Japan advocates setting the price cap on currently regulated prices of prescription drugs. However, the Japanese Medical Association and the pharmaceutical industry both criticize the capitation plan by pointing out the risk of jeopardizing equal access to health care services among people under the national health care system.[3] In the end, the price cap on prescription drugs has not been put into practice except for limited categories of medical practices for elderly people.

As the natural consequence of the Japanese government price regulation on prescription drugs, the price control provides physicians the opportunity to over-prescribe drugs to patients under the cost-based fee-for-service (FFS) reimbursement system, since the regulated price of prescription drugs is set higher than the market-traded price. The prescription drug overuse is reinforced by the fact that the out-of-pocket expenses for prescription drugs by patients are kept low by the national health care system. Furthermore, the FFS reimbursement system and the large positive price margin between government regulated prices of prescription drugs and the market-traded prices have kept prescribing drug and dispensing drugs at the same medical institution. The regulated pricing under the FFS reimbursement system has stalled the increase in the rate of separation of prescribing and dispensing drugs to be at different medical institutions. This rate remains at a low thirty-five percent in Japan. Because of the increasing share of medication and injections in total medical expenditures, the MHLW instituted a modified cost-based reimbursement system, the capitation scheme, which shows to some extent a promising sign in curbing increases in total medical expenditures. However, its application continues to be limited to elderly inpatients at specially accredited hospitals.

At present, the regulated pricing system and the low rate of separation contribute to the misallocation of human resources at hospitals, both of which create inefficiency in the health care provision in Japan. In this paper, we argue that: (1) a capitation on reimbursement prices for prescription drugs may reduce the prescription drug overuse, and (2) furthering the separation policy would increase hospital production efficiency while lessening the over prescribing of drugs. To support our arguments, we also present an evaluation of the capitation method in increasing efficiency in hospitals.

BACKGROUND

Government reimbursement for medical services follows the point system created by the Ministry of Health, Labor, and Welfare (MHLW). Medical services are classified as follows: medication, injections, examination, hospital services, general treatment, radiology, mental treatment, anesthesia, basic consultation, home care, image diagnosis, operation, and physiotherapy. These general categories are further stratified into sub-categories depending on the resource usage of those medical services. Each category is assigned a certain number of points, and the reimbursement price is simply the number of these points multiplied by ten yen, which is equivalent to less than a dime per point at the current exchange rate. This unified point scheme under the current fee-for-service system applies to all medical service providers regardless of the different types of medical insurance coverage, such as the health insurance for employees in private firms, for public employees as well as teachers and for farmers and proprietors. The unified point scheme aims to generate enough revenue to cover the costs incurred by medical service providers. At present, medication and injections account for approximately 22-24% of the total reimbursement points generated by medical service providers.

In 1990, the MHLW modified the reimbursement schedule by setting a maximum number of points a medical service provider can receive for one day. This capitation method has only been applied to four service categories (nursing, medication, injections, and examination) for elderly patients[4] at specially accredited hospitals. These specially accredited hospitals can choose either the fee-for-service program or the capitation scheme as the cost reimbursement schedule. In general, this choice affects hospital management and the procedural orientation of the hospital.

The government regulates the prices of prescription drugs under the cost reimbursement schedules of the National Health Insurance framework. The regulated prices are set uniformly for the whole country by the MHLW. The purpose of the regulation is twofold: to encourage research and development, and to maintain the National Health Insurance System.[5,6] The total number of regulated prices of prescription drugs set uniformly for the whole country by the MHLW is approximately 12,000.[7] The regulated pricing is set according to the following formula:[8]

Regulated price = weighted average market purchase price before consumption tax +[1+(1+Local consumption tax rate) x National consumption tax rate] + adjustment zone.[9]

The fundamental purpose of the adjustment zone is to restrain and discourage over prescribing drugs, while the secondary purpose is to stabilize and efficiently distribute the drug market. The regulated pricing system, however, creates the price margin (so-called "*yakkasa*" in Japanese) between the regulated price, i.e. reimbursement price from the government, and market-traded price. The former is usually higher than the latter.[10]

In the above pricing formula, the weighted-average market purchase price, which is the basis of the reimbursement fee for prescription drugs, is not necessarily equal to the market-traded price of individual drugs. For hospitals and clinics the physician's purchase price is determined through private negotiations with a pharmaceutical company or a wholesaler. If the individual purchase price is lower than the weighted-average market purchase price, it creates a price margin that will be larger than the pre-calculated adjustment zone.[11] Since it is this price margin that goes to the medical institutions, the larger the price margin that is received, the higher the margin to be received from the reimbursement. Since medication is also assigned a certain number of points for reimbursement that induces more prescription per capita, it induces prescription drug overuse under the FFS reimbursement system. Although the MHLW has instituted a series of reductions in regulated prices that would discourage the moral hazard among physicians of over-dispensing drugs to patients, the consequences are still ambiguous and unclear.[12]

On the other hand, the MHLW also tends to set higher prices for new drugs entering the market despite near similarities of quality and effects with existing drugs in the market. This price control policy also has a negative influence on pharmaceutical producers and physician because the price evaluation for new drugs tends to reduce the relative regulated price of existing drugs in the market compared to the incoming ones. This reduction gives incentives to pharmaceutical companies to produce and market marginally improved products to maintain profits. With the same profit goal in mind, physicians and pharmacists are willing to purchase newly produced drug products.[13] In short, purchasing new but marginally improved drugs increases the net revenues to hospitals and pharmacies.[14] These corroborating situations among pharmaceutical companies (or wholesalers), physicians and pharmacists bring about the overproduction and overprescription of drugs in the medical sector. This further results in inefficient medical institutions being able to stay in the medical sector.[15, 16]

The following are examples of the current cost reimbursement schedules:

Medication fee (inpatient) = prescription fee (42 points) + preparation fee (7 points per day)

+ medicine fee [1+(regulated drug price-15yen)/10]

+ preparation and basic skill fee (42 points per usage of service in a month)[17];

Medication fee (outpatient) = prescription fee (29points) + preparation fee (9 points per time)

+ medicine fee [1+(regulated drug price -15yen)/10]

+ preparation and basic skill fee (8 points per usage of service in a month); and

Injection fee = skill fee + medicine fee [1+(regulated drug price -15yen)/10].

The regulated drug price underlies the reimbursement fee from the government insurance agency, and this reimbursement fee depends on the drug that the physicians choose. Therefore, physicians tend to choose drugs with large price margins because of the added net revenue to the medical institution. In addition, a patient's out of pocket expenses on prescription drugs are minimal and co-payments are very small because they are covered by the National Health Insurance system. Consequently, patients have little incentive to look for and buy less expensive drugs, and this causes physicians to have little interest in obtaining lower priced drugs for the patients. Under the current regulated reimbursement drug price system, a policy to limit the pervasive moral hazard among market participants in the medical sector is indispensable in order to mitigate not only the health insurance tax burden on the employed population but also to curtail the rapid increases in medical expenditures by the elderly members of sociey.[18]

EMPIRICAL FRAMEWORK

3-1 Role of regulated pricing in separation and usage rates

The relationships among the regulated drug pricing, prescription drug overuse, and misallocation of human resources, all of which represent inefficiency in health care production, are presented in the lozenge relation of regulated drug pricing and hospital efficiency in Figure 1. The lozenge relation illustrates the mechanics of how government regulated prices affect health care outputs in a hospital.

The existence of the price margin (a positive gain due to the difference between the government regulated prescription drug price and market-traded drug price) contributes to maintaining the low rate of separation of prescribing from dispensing drugs, the excess supply of drugs by pharmaceutical producers, and the overprescription (over-consumption) of prescription drugs by physicians to patients. As depicted in Figure 1, the top of the lozenge relation shows the strong relationships among these factors.

Let us explain some of the important relationships. Regulated pricing directly affects the rate of usage of prescription drugs by:

(1) controlling the number of medicines available for prescription drugs covered by insurance;

(2) creating a glut in supply by setting the regulated price of prescription drugs above the market equilibrium price; and

(3) inducing the demand among physicians for new, more expensive drugs with little consideration to the net benefits that can be given to patients.

Regulated pricing also affects the human resource allocation in the medical sector such that, the net gain from the price margin provides more incentives for medical institutions to employ more pharmacists and related personnel. Hence, the wages for personnel in the medical sector will be more appreciated than wages in other sectors in society. The low-rate of separation, the consequent misallocation of human resources, overproduction, and use of prescription drugs all contribute to the inefficiency of the health care system in Japan.

3-2 Efficiency evaluation

In the previous section, the highlighted lozenge ration illustrated the mechanics of how government regulated drug prices affect hospital production of health and medical health care service. It also shows how the application of the government policy affects hospital behavior. Now, in Figure 2, we evaluate efficiency in a multifaceted method. Efficiency evaluation is defined as a series of four stages: (1) implementation evaluation, (2) process efficiency evaluation, (3) impact efficiency evaluation, and (4) output efficiency evaluation.

At the implementation stage, the government policies may or may not affect the hospital administration's decision to apply the status to implement the capitation system of reimbursement. The process efficiency at the second stage involves evaluation of the resource-input mix at hospitals subject to the government guidelines and policies. In this respect, we will attempt to empirically quantify how efficient the current level of input resources is in the production of health and medical health care services for outpatients and inpatients. Concerning the last two stages of impact and output efficiency, we also try to measure the effect of government intervention on the hospital production.

In our empirical model specification, we assume efficiency evaluation on the production of health and medical care services in the hospital can be quantified and use the following structural model of the production function:

$$Q_i = \beta_0 + \beta_1 HR_i + \beta_2 PHD_i + \beta_3 EQ_i + \beta_4 CH_i + \beta_5 OT_i + e_i,$$

where Q_i represents health and medical care services output at the i_{th} hospital per period, HR_i human resource inputs; PHD_i prescription drug usage rate; EQ_i equipment and other capital inputs; CH_i patient characteristics; OT_i other factors which affect the supply of health and medical care services; β_i are structural parameters to be estimated, and e_i is a random disturbance term.

By using the above regression model, we will evaluate the effect of government policies on the production-input mix in hospitals (process efficiency evaluation). The model is also used to evaluate the impact of regulated pricing of prescription drugs on hospital production (impact efficiency evaluation). In order to evaluate output efficiency, a frontier production function is used to measure technical efficiency.

For the first set of our empirical specifications, we focus on the regulated pricing system.[19] We will quantify the effect of the regulated pricing system on outpatients and inpatients in combination with a set of human resource inputs such as physicians, pharmacists, and registered nurses in the hospital production.[20] The regulated pricing intervention creates a price margin that influences the usage rate of prescription drugs by physicians in hospitals and the use of hospital resource inputs – especially physicians and pharmacists. This price margin is negatively related to the market-traded price but positively related to the government-regulated price. The large price is an important revenue-generating method to maintain the hospital financial status.[21] Thus, the larger the price margin is, the higher the rate of prescription drug use would be. Therefore, by using the above mentioned hospital production function of health and medical care services, we can analyze the efficiency of price regulation on prescription drugs.

Next, we focus on the effect of the low rate of separation of prescribing drugs from dispensing drugs. Since a full separation means that drugs are prescribed by physicians at a medical institution and are separately dispensed by another medical institutions rather than the same institution (a hospital) handling both, a hospital with the full separation would employ fewer pharmacists. In reality, a large proportion of general hospitals still assumes both roles. Then, to evaluate the effect of the resource mix on the over usage of prescription drugs and inefficiency in the hospital production, we indirectly examine the effect of the number of employed pharmacists on outpatients and inpatients and on accumulated reimbursement points at hospitals.

3-3 Evaluating the capitation reimbursement scheme

The capitation reimbursement scheme sets a limit on the number of points the hospital can accumulate per patient on a per day basis; the scheme is only applied to four categories of medical services: nursing, medication, injections and examination. The reimbursement scheme that a hospital adapts, whether it is the FFS or the capitation reimbursement scheme, affects not only the physician's but also other medical staff's delivery of health and medical care services because the physician employs all medical inputs (or uses all information provided by other medical staff) to produce a basic unit of patient health and medical care services.[22] Thus, the choice of capitation may depict some aspects of efficiency including the drug usage rate in hospitals.[23] To show how the usage rate of prescription drugs under the capitation scheme affects hospital production efficiency, we estimate a frontier production function, which enables us specifically to find out the rate of average efficiency in the hospital production of health and medical care services. For a comparative study, we also estimate the same production function applied to general hospitals with the FFS program and specially accredited hospitals with the capitation scheme.

3-4 Data sets

We use the data on 546 accredited geriatric hospitals with and without the capitation scheme and 6,651 general hospitals, obtained from the *1993 Static Survey on Medical Institutions* and *1993 Survey on Hospital Reports*. These two micro survey data are highly useful in evaluating the behavior of hospitals for the purpose of this study since the surveys were made after the implementation of the capitation reimbursement scheme in 1990. The *1993 Static Survey on Medical Institution,* especially, has various kinds of information regarding medical facilities except for costs and personnel; while the *1993 Survey on Hospital Reports* provides information on medical personnel.[24] Hence, our analysis of both sets of survey data will provide a general overview, albeit in detail, of the behavior of hospital production under the current National Health Insurance system in Japan.

DISCUSSSION OF EMPIRICAL FIDINGS

4-1 Reduction rate in regulated prices

Table 1 shows the average rate of reduction in the government regulated prices of prescription drugs (%), total reimbursement points for inpatients and outpatients, and the share of medication and injections (M&I) in total medical expenditures per episode of illness (%), for both elderly and non-elderly inpatient and outpatients from 1987 to 2000.

As shown under the RP column in Table 1, the government has historically lowered the regulated reimbursement points, which by multiplying by ten will give the regulated reimbursement prices, that hospitals can claim from prescription drugs. The lower the regulated points are the lower the price margins would be. After adjusting the values of the RP% by setting the value of 1987 equal to 1, the rates of reduction in the regulated reimbursement points are 46.2% from 1987 to 2000 and 35.7% from 1990 to 2000.

Regarding the share of elderly inpatient's medication and injection in the total points per episode of inpatient illness (M&I Inpatient Share), the share declined from 22.7% in 1987, 20.5% in 1990, to 13.0% in 2000. If we multiply the share to the total points, we will get the points of medication and injections of elderly inpatients (M&I elderly inpatient points) such as 6930.17 in 1987, 6154.78 in 1990, and 4914.0 in 2000.[25] The rate of reduction of the M&I elderly inpatient points is 20.16% from 1990 to 2000. By the same calculation, the rate of the reduction for the M&I elderly outpatient points, 27.27%, is obtained for the same period.

Since the M&I points are the product of the government regulated reimbursement points and units of medication and injection (i.e., M&I), we can identify the rate of change in the number of units of M&I by taking the difference between the rate of change in the M&I points and the regulated reimbursement points for a given period. For example, the rate of reduction of the M&I elderly inpatient points is 0.2016 from 1990 to 2000 as shown above and the rate of reduction in the regulated points is 0.3572 over the same period. The difference, i.e., positive 0.1556 (=0.3572-0.2016), becomes the rate of change in the units of M&I prescribed to elderly inpatients.[26] Hence, what we see of this positive 0.1556 is that the reduction in the government regulated reimbursement points brought about rather an increase in the unit of medication and injection for elderly inpatients from 1990 to 2000. We obtain the same positive result for the case of elderly outpatients such as 0.3572-0.2727=0.0845 from 1990 to 2000. These positive results seem contradictory to the government policy, aiming at reducing the overprescription of drugs by physicians to patients.[27]

The positive rate of units of medication and injections (M&I) over the period may be explained as thus. Since a series of reductions in the government regulated pricing of prescription drug resulted in a smaller price margin per unit of prescription drugs, physicians circumvented the loss by altering the number of outpatient's visits per episode of illness with the same quantity of prescription drugs per visit and/or by increasing the quantity of prescription drugs per visit with the same number of visits per episode. These two explanations can't be excluded from possibility. For example, outpatients can either dispose of drugs with discretion or put them in drawers for the next time since they know the same type of drugs will be prescribed if they see physicians for the same reasons. At least, keeping drugs for next time will save their visiting their physician. On the other hand, it is highly unlikely for physicians to increase the quantity of drug dosage per episode of illness for inpatients since the per-day quantity and frequency of dispensing drugs to inpatients is generally scheduled at the hospital. However, the better or highly probable explanation for the increase in the number of units of prescriptions and injections to patients will be the substitution of more expensive prescription drugs for less expensive ones.

In summary, we have the following three possibilities to explain the increase in the rate of change in the units of M&I points: since the percentage reduction in the M&I points is less than that in the regulated prices,

(1) Physicians substitute relatively higher priced drugs for drugs whose regulated prices fell.

(2) Physicians induce the demand for prescription drugs.

(3) Physicians increase the number of prescription drugs by shifting the supply curve to the right.

4-2 Impact and output efficiency evaluation

This section discusses the results in Tables 2, 3-1 and 3-2. Table 2 reports the regression results of general hospital production functions for both outpatients and inpatients, which are estimated by the 2-Stage Least Squares method (2SLS). In this model, the health and medical care services for both outpatients and inpatients are assumed to be simultaneous in the hospital production functions.

In Table 3-1, we report and highlight only the estimated regression results of the effects of prescription, treatment days, and units of service on accumulated points (i.e., total reimbursement points) for three different types of hospitals – general hospitals, specially accredited hospitals with the capitation scheme, and the accredited ones with, a cost-based fee-for-service scheme. The latter two types of hospitals are functionally classified as hospitals for elderly health and medical care, but these hospitals need to be accredited by the government first in order to choose which reimbursement they will apply.

Table 3-2 reports and highlights only the estimated coefficients of the effects of regulated prices, treatment days, and units of service (all of which are explanatory variables) on each of the treatment days and units of service regressions for different types of illness. Explicit in these models, we hypothesize that the treatment days and units of service are simultaneously determined in the hospital productions. Thus, the units of service variable appears as the explanatory variable in the treatment days regression, whereas the treatment days is used as the explanatory variable in the units of service regression, while the regulated prices appears as the explanatory variable in both regressions.

The 2SLS regression results of outpatients and inpatients at general hospitals are requested in Table 2, where we report only the highlighted variables for clarity. The estimated coefficient of the variable on total number of prescriptions (which is specifically defined as the total number of drug prescriptions for outpatients per week) is 0.034 and –0.015 in the regressions of outpatients (specifically, the number of outpatient's visits per week) and inpatients (specifically, the number of inpatients a day), respectively. Both estimates are highly and statistically significant. Since the models are specified in a double logarithmic form, the estimated coefficients on continuous variables are interpreted as elasticity. That is, the value of 0.034 for the effect of total number of prescriptions on outpatients shows that a one-percent decrease (increase) in total number of prescriptions reduces (raises) the number of outpatients by 0.034%. In the contrast, the negative sign for inpatients, -0.015, means that a one-percent decrease in the number of prescriptions leads to a 0.015% increase in inpatients. Both influences are numerically small, but the implications are important and should not be ignored.

If one supposes that the law of diminishing marginal productivity holds in the hospital production of health and medical care services, the positive sign on the estimated coefficient of prescriptions for outpatients follows the law since the marginal product is positive, but the negative sign for inpatients indicates that the marginal product is negative. In addition to the negative sign, the estimated coefficient on the pharmacist variable is also significantly negative for inpatients, i.e., -0.142, in Table 2. Hence, the excessive usage of prescription drugs and pharmacists is indicative of the inefficiency in inpatient care at general hospitals.

Furthermore, the inefficiency illustrated above seems to be supported by the negative marginal effect of prescriptions on the total reimbursement points (-0.94) at general hospitals (in Table 3-1). This negative value indicates that the number of prescription drugs at general hospitals exceeds the optimum level that maximizes total reimbursement points. On the other hand, the specially accredited hospitals without the capitation scheme highly specialize in prescribing drugs to elderly patients (the effect of prescriptions is significantly positive, 123.65 in Table 3-1), while those with the capitation do not necessarily do this (i.e., an insignificant estimate of 15.52).

Next, of the models in Table 3-2, we examine the effects of lowering the government regulated reimbursement prices of prescription drugs on treatment days and units of service for different types of geriatric illness. The results show the effects of the regulated prices on treatment days and units of service are all negative except for the case of mental illness. That is, lowering the government regulated reimbursement points actually increases treatment days of elderly patients and also units of service at hospitals; these results are congruent to and support our previous explanations in the section 4-1. Now, it is clear that physicians are making up a loss due to the lower price margin of prescription drugs by increasing treatment days and units of service.

Since the values in Table 3-2 are all in terms of elasticity, the size of the effect of a change in government regulated prices is such that a one-percent reduction in the regulated price leads to a 11.15% increase in treatment days and a 9.27% increase in units of service for the case of geriatric illnesses. In the case of cancer, the effects are a 5.96% increase in treatment days and a 1.28% increase for units of service. The interaction between treatment days and units of service is simultaneous and the relationship is negative such that an increase in treatment days will cause a reduction in units of service, and vice versa.

4-3 Capitation reimbursement and prescription drugs

In Table 4 we examine how the characteristics of specially accredited hospitals affect their choice on the reimbursement scheme for health and medical care services for elderly patients: the capitation method or the cost-based fee-for-service (FFS) program. We assign 1 for the hospitals with the capitation scheme and 0 for hospitals without this in the logit model. The capitation method is applied only to the four service categories (nursing, medication, injections, and examination) for elderly patients. The positive sign on the estimated coefficient of the total number of prescriptions shows that the hospitals, which are prescribing more drugs, tend to choose the capitation method rather than the FFS reimbursement method. However, the estimated coefficient is not statistically significant.

First, as shown in the table, the estimated coefficients of human resources such as pharmacist and physicians are negative -1.183 and -0.762, respectively, and these estimates are statistically significant. These negative results imply that specially accredited hospitals with fewer numbers of pharmacists and physicians are likely to choose the capitation method rather than the FFS reimbursement method.

For the above negative effects, we consider the following reasoning. First of all, any hospital that wants to be approved as a specifically accredited hospital must meet the specific government requirement on the appropriate number of medical staff. However, the requirements to become a specifically accredited hospital are less stringent than a hospital to be approved as a general hospital, since the former functions as a geriatric hospital and needs fewer medical facilities and also fewer numbers of medical staff including pharmacists and physicians per hospital. Therefore, after a hospital becomes a specifically accredited hospital, if the hospital has to provide elderly patients basic units of health and medical care services with limited number of medical facilities and staff, the choice of the capitation method may be more profitable rather than choosing the FFS reimbursement program.

Furthermore, elderly patients normally do not need a variety of complicated medical treatments (i.e., highly intensive medical treatments by physicians), unlike non-elderly patients, which may be provided by nurses and other medical staff. This explanation is supported by the significantly positive estimated coefficient on the variable of registered nurse, 1.313.

Second, Table 5 now shows, by estimating a hospital frontier production function, how much more efficiently specially accredited hospitals are producing health and medical care services to outpatients and inpatients. The results give us not only the estimated coefficients of explanatory variables (prescriptions, pharmacist, physician and registered nurse), but also an estimation of mean technical efficiency for its production.[28] Here, the estimated coefficients of the variables on pharmacist and physician are respectively 0.285 and 0.340 in the outpatient equation and these positive estimates are statistically significant. On the other hand, the respective coefficients, -0.021 and 0.043, are not statistically significant in the inpatient equation, while the estimate on the registered nurse variable is 0.101 and is statistically significant. Therefore, what we can see from the two frontier production estimates is that medical staff, like pharmacists and physicians, are relatively more productive in treating outpatients rather than treating inpatients in specially accredited hospitals. On the contrary, registered nurses are more productive for providing care to inpatients than to outpatients.

Furthermore, the results in Table 5 also show that the inpatient variable is not statistically significant in the outpatient equation and the outpatient variable is also not significant in the inpatient equation. That is, the health and medical care services to outpatients and inpatients are not simultaneously determined at specially accredited hospitals. In other words, the specially accredited hospitals might be better off or more efficient if they specialize in either outpatients or inpatients and allocate their human resources accordingly. The answer to the efficiency in producing health and medical care services at specially accredited as well as general hospitals are provided in Table 6.

It is of interest now to evaluate a mean technical efficiency related to hospital output production. Table 6 provides the estimated mean efficiencies for outpatients and inpatients in general hospitals with the FFS and specially accredited hospitals with the capitation method. Now, our results indicate that general hospitals are relatively more efficient in the production of outpatients, while specially accredited hospitals are rather relatively more efficient in the production of inpatients.

The reason is as follows: an estimate of technical efficiency in the frontier production function tells the mean technical efficiency in percentage. For example, the technical efficiency for general hospitals with the FFS reimbursement program in the production of health and medical care service for outpatients is 0.521, and the value for inpatients is 0.639.[29] As far as these values are concerned, general hospitals are more efficient in the output production for inpatients rather than for outpatients, simply because the absolute value of mean technical efficiency for the former is 63.9%, whereas the value for the latter is 52.1%. However, if we make a comparative study of these results with those of specially accredited hospitals with the capitation scheme, we will come to the conclusion that general hospitals are relatively more efficient in producing health and medical care services to outpatients rather than to inpatients.

The mean technical efficiency for specially accredited hospitals with the capitation program is 0.455 in the hospital production for outpatients and the value of the efficiency is 0.856. Hence, specially accredited hospitals with the capitation are more efficient in the hospital production for inpatients (85.6%), than for outpatients (45.5%). Furthermore, the mean technical efficiency of inpatients at specially accredited hospitals with the capitation shows its production is not only absolutely but also relatively more efficient than the production for inpatients at general hospitals with the FFS reimbursement program (0.639). On the other hand, when we compare the mean technical efficiency in the hospital production for outpatients between general hospitals with FFS and specially accredited hospitals with the capitation, the value of the former (0.521) is larger that that of the latter (0.455). Hence, the general hospitals are relatively more efficient in the production of health and medical care service for outpatients than the specially accredited hospitals.

Hence, in terms of a comparative advantage in the hospital production, specially accredited hospitals with the capitation are comparatively more advantageous in specializing in the production for inpatients, but general hospitals with FFS are comparatively better off if they specialize in the production of health and medical care service for outpatients. Therefore, if those human resources such as pharmacists and physicians can be marginally transferred from specially accredited hospitals with the capitation to general hospitals with the FFS, while other medical staff, like registered nurses, are moved the other way around, this human resource re-allocation will improve efficiency in the hospital production of health and medical care services and will further result in an improvement in the social welfare in a Pareto sense for the country.

SUMMARY AND CONCLUSION

5-1 Expert Opinion

The Japanese regulated pricing of prescription drugs influences drug utilization by physicians and pharmacists in hospitals. Prescription drug overuse is considered to be a major factor responsible for the increasing medical expenditures in this country. This paper argues for a capitation on the reimbursement for prescription drugs and a further promotion of the separation policy between the prescribing and the dispensing of prescription drugs.

The empirical results of this study show that the regulated pricing causes the biased allocation of resources. First, the number of prescriptions exceeds the optimal level, which results in the inefficiency of hospital production of health and medical care services. Overprescribing exceeds the optimum that maximizes the points for government reimbursement. This shows that overprescription increases existing inefficiencies in hospitals. Second, the results show that due to the negative relationships between the regulated prices of prescription drugs and treatment days and between the prices and units of service, the government regulated price reductions instituted by the Ministry of Health, Labor, and Welfare (MHLW) during the last decade have had little impact on discouraging physicians from over dispensing drugs to patients.

Third, the regulated pricing system also contributes to the inefficient human resource allocation in hospitals (particularly pharmacist over-employment with respect to inpatients and registered nurse over-employment with respect to outpatients, which in turn contributes to the lower efficiency in general hospitals. If hospitals, including both general and specially accredited hospitals, were to allow fewer pharmacists and physicians but more registered nurses to provide services to inpatients than the current levels while doing the opposite for outpatients, efficiency in hospital production would improve. Furthermore, if general hospitals were to specialize in outpatient while specially accredited hospitals specialize in inpatients, the social welfare in a Pareto sense would improve.

Finally, as a means of comparison, the study highlights and evaluates the effectiveness of the capitation scheme in curbing medical expenditures with respect to prescription drug usage. Prescribing and dispensing drugs are not significant factors contributing to the production inefficiency in specially accredited hospitals with the capitation method, but they become significant factors in general hospitals and specially accredited hospitals with the cost-based fee-for-service method.

5-2 Five-Year View

Under the government regulated pricing of prescription drugs, hospitals with the cost-based fee-for-service method tend to rely on the revenue from prescription drugs. At a glance, using a market-oriented price mechanism might be a policy option to reduce prescription drug overuse. However, our findings imply the need to show caution for thoroughly relying on a market mechanism for the pharmaceutical distribution. In contrast, we offer the following policy alternatives as viable options to improve efficiency in the health care sector.

A transition from the cost-based fee-for-service method to a capitation scheme with quality control is a possibility for hospitals and clinics to restrain the rapid increase in spending on prescription drugs as well as to limit unnecessary use. Also, establishing the mandatory requirement for a detailed fee-for-service account by physicians and/or pharmacists should be made accessible to the patient and her family, and to the public. The fee-for-service accounting would allow patients and others to carefully monitor the use of prescription drugs and possibly prevent the problem of overprescribing.

Under the current flat co-payment system for pharmaceutical drugs, consumers/patients do not have incentives to search for lower-priced drugs among the alternatives. Thus, low prices with a maximum cap co-insurance payment will be a viable policy option in the future.

The revision of prices for currently marketed drugs based on efficacy rather than length of time in use is another policy option to discourage the exploitation of the reimbursement schedule. Furthermore, establishing an independent drug price control organization to decide and/or evaluate pharmaceutical prices is an urgent policy issue since the evaluation, at present, depends on the suggestions made by the pharmaceutical industry. A furthering of the separation policy is certainly another means to curb prescription drug overuse in hospitals.

5-3 Key Issue

The regulated pricing is not merely a health care policy that affects the equal access to pharmaceutical drugs by consumers/patients under the national health insurance framework. It is also an industrial policy for the pharmaceutical industry to encourage research and development to produce safe, effective and marketable drugs with epoch making characteristics. Our empirical study shows that the regulated prices negatively affect the efficiency of hospitals. The change in the reimbursement method from the current fee-for-service to the capitation would mitigate some of the inefficiency problems under the current national health insurance framework. In addition, separating prescribing from dispensing could mitigate some aspects of the efficiency problems. Thus, while maintaining equal access to health and medical care services, a reference price control with a flexible price range control (a cap price) by involving an independent price decision organization, would be a viable option.

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1. Health Insurance Research Association, 2002. *White Paper on Health Insurance.* (In Japanese, Me *de Miru Iryou Hoken Hakusho*) Tokyo: Gyousei.

   For other western countries, the values are 16% in the U.K., 17% in France, and 12% in Germany.

2. Health Insurance Bureau, Ministry of Health, Labor and Welfare. 1993, 2000 and 2003. *Survey of Medical Treatments.* (In Japanese, *Shakai Iryou Shinryou Koui-betsu Chosa Houkoku*) Tokyo: Welfare Statistics Association.

   In the period 1990-2000, the ratio of medication and injection costs per episode of illness to total medical expenditures reimbursed from the Japanese government ranges from 12-18% for general (non-elderly) inpatients, 31-42% for general outpatients, 13-21% for elderly inpatient, and 39-52% for elderly outpatients in Japan.

   Health Insurance Bureau, Ministry of Health, Labor and Welfare, 2000. *Survey of Medical Treatments.* (In Japanese, *Shakai Iryou Shinryou Koui-betsu Chosa Houkoku*) Tokyo: Welfare Statistics Association.

   Health Insurance Bureau, Ministry of Health, Labor and Welfare, 2002. *Survey of Medical Treatments.* (In Japanese, *Shakai Iryou Shinryou Koui-betsu Chosa Houkoku*) Tokyo: Welfare Statistics Association.

3. A study made on the U.S. health care systems shows that a regulated price cap that takes into consideration social (welfare) and corporate discount rates creates a negative consumer surplus in the early period which becomes positive in the later periods and thus, the regulated price cap is higher than the unregulated price in the early period. See: Abbott III, Thomas A., 1995. Price Regulation in the Pharmaceutical Industry: Prescription or Placebo? *Journal of Health Economics*, 14: 551-565.

   * This study analyzes the costs and benefits of a price cap on the U.S. pharmaceutical industry and shows the reaction of the industry toward the policy.

4. "Elderly" refers to those who are 70 years and older. Someone aged between 65 and 69 years old can also hold an Elderly Health Insurance because of her physical condition, e.g., bedridden persons, as approved by the National Health Insurance system.

5. Ministry of Health, Labor and Welfare, 2000. *The Problem of Health Care Reform* (In Japanese, *Iryo-seido Kaikaku no Kadai to Shite*). Tokyo: Central Office for the Reform of Elderly Health Care.

   * This government paper explains the regulated drug pricing in Japan.

6. Nanbu, Tsuruhiko. 1995. Challenges to the Japanese System. In Pharmaceutical Benefit

Scheme and Quality Care. Tokyo: Pfizer Health Research Foundation.

** This article discusses the problems of regulated pricing on prescription drugs in Japan. The author recommends a market-oriented policy for the distribution of prescription drugs.

7. Pharmaceutical Economics Research Association. 2002. Medical & Pharmaceutical Industry. Tokyo: Jihou.

   ** This book, written in Japanese, is comprehensive in its listing: pharmaceutical distribution, pharmaceutical production and R&D, regulated pricing, pharmaceutical laws and regulations, safety guidelines, and the Japanese health insurance system as it is related to price controls.

8. C.f. endnote 7

9. The adjustment zone may be negative or positive.

10. C.f. endnote 5

11. If the price margin would equal the adjustment zone, the reimbursement price would be exhausted. However, the existence of the price margin makes the individual purchase price lower than the reimbursement price, consequently increasing hospital revenue.

12. Shimada N. and Y. Shirasaya. 1999. Estimation of the Demand for Drugs at Hospitals (Iryou kikan ni okeru yakuzai-juyou-kansu no suitei). In Research on Demand Price Elasticity in Health Care Reform on the Increase in Out-of-Pocket Payments (in Japanese, Iryo-hi no Jiko-Futan-Zou ni Tomonau Iryou Juyou no Kakaku Danryoku-sei ni kansuru Kenkyu), ed. Tsuruhiko Nanbu. Tokyo: Institute of Health Economic Policy.

    ** This is a study on the price elasticity of Japanese prescription drugs and finds that price elasticity appears to be related to the preference behavior of medical institutions and not to competition in the pharmaceutical industry. The study makes an empirical study using data on market-traded drugs.

13. Ikegami N., S. Ikeda, and H. Kawai. 1998. Why Medical Care Cost in Japan have Increased Despite Declining Prices for Pharmaceuticals. Pharmacoeconomics, 14: 97-105.

    * This article points to the tendency of Japanese physicians to use high-priced newly introduced drugs following cuts in the regulated prices.

14. Oliver A.J., N. Ikegami, and S. Ikeda. 1999. Effect of Japanese Government Policy on Hospital Pharmaceutical Profit Levels. *Journal of Health Services Research & Policy*, 4: 27-32.

    * This article describes the relationship between drug profit margins of hospitals and the

price reduction policy by the Japanese government.

15. Thomas III, L.G.. 1995. Japan in Pharmaceuticals. In *Pharmaceutical Benefit Scheme and Quality Care*. Tokyo: Pfizer Health Research Foundation.

    * This article discusses physician-dispensing activities, the Japanese regulated pricing system, and the pharmaceutical market; in addition, the article makes a comparative study on the U.S. and Japan.

16. Ogura S. and T. Hagino T. 2002. Nihon no yakka seido no bunseki. In *Japan-U.S. Comparative Studies on Health Care Systems Reforms* (in Japanese, *Nichi-bei Hikaku Iryou Seido Kaikaku*, eds. Seiritsu Ogura and David A. Wise. Tokyo: Nihon Keizai Shinbun Sha.

    ** This article, written in Japanese, analyzes the causes of the increased spending on prescription drugs in Japan as related to regulated prices and the price margin. This also evaluates medical service provider's drug selection behavior and finds that the major factor is the physician-shifting behavior.

17. In other words, if a patient visits twice in a month, this preparation and basic skill fee will only be charged once.

18. In contrast, the population growth during the decade was a mere 2.7%, of which 78% was the proportion of the elderly population.

19. Our analysis does not differentiate the specific role of physicians and pharmacists regarding the decision of dosage of the chemical compound and the choice of branded or generic drugs.

20. Canton E, and Ed Westerhout. 1999. A Model for the Dutch Pharmaceutical Market. *Health Economics*, 8: 391-402.

21. C.f. endnote 6.

22. For more in-depth analyses of the capitation scheme in Japan, see: Yamada, Yamada, Ogura and Suzuki, "Hospital services under a national health insurance system: transition from a fee-for-service to a capitation system," in *The Economics of Health Care in Asia-Pacific Countries*, eds. Teh-Wei Hu and Chee-Ruey Hsieh, 2002: 213-238.

23. Based on the U.S. experience, capitation reimbursement method discourages incentive to provide extra and/or unnecessary services that increase the costs of health care expenditures.

24. The availability of the survey data is limited to research made by government or quasi-government organizations. We have no access to information on costs in hospitals.

25. The points of medication and Injection (M&I) are obtained from multiplying total points (inpatients or outpatients) by the corresponding M&I shares. For example, the points of

the M&I inpatients in 1990 and 2000 are: 30,023.3x0.205= 6154.78 and 37,799.8x0.130=4914.0, respectively. Hence, the rate of the reduction is 20.16% (=(6154.78-4914.0)÷6154.78) from 1990 to 2000. The points of the M&I outpatients in 1990 and 2000 are 1,885.3x0.508=957.73 and 1,786.1x0.390=696.6, respectively, Hence, the rate of the reduction for outpatients during the period is 27.27%.

26. M&I points = (government regulated reimbursement points) x (number of units of medication and injection). Hence, ln (number of units of medication and injection) = ln (M&I points)-ln(government regulated reimbursement points), where ln represents the natural logarithm. Then, if we take derivative of the double log equation with respect to time, we can have the percentage change in the number of units of medication and injection equal to the difference between the percentage changes in the M&I points and government regulated reimbursement points. For example, the percentage change in number of units of inpatient's medication and injection from 1990 to 2000 is 0.1556= -0.2016 – (-0.3572).

27. However, if we divide the period from 1990 to 2000 into two periods such as 1990-1995 and 1995-2000. We do not have always the positive value. In fact, we observe the negative values for elderly inpatients for 1990-1995, elderly outpatients for 1995-2000 and non-elderly inpatients and outpatients for 1995-2000.

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29. The justification and some advantages of using a stochastic frontier regression (SFR) over a data envelopment analysis (DEA) are seen in the studies by Aigner, Lovell and Schmidt (1977), Jondrow, Lovell, Materov and Schmidt (1982), Bradford, Kleit, Krousel-Wood and Re (2001) and Rosko (2001). The value of mean technical efficiency is obtained as follows. The value of mean technical efficiency is obtained as follows. We will have a measure of mean technical efficiency, defined as (Maddala 1983): $E(e^{-u}) = 2\exp\left(\frac{\sigma_u^2}{2}\right)[1-\Phi(\sigma_u)]$ where $\Phi(\cdot)$ is the standard normal distribution function. We estimate SIGI and LAMBDA from the frontier production function by

using the TSP. SIGI is defined as $SIGI = \left(\frac{1}{\sigma_\varepsilon}\right)$ where $\sigma_\varepsilon^2 = \sigma_u^2 + \sigma_v^2$. Also, $\lambda = \frac{\sigma_u}{\sigma_v}$ and $\sigma_u^2 = \left(\frac{\lambda^2\sigma_\varepsilon^2}{1+\lambda^2}\right)$.

Figure 1. Regulated Drug Pricing and Hospital Efficiency: A Lozenge

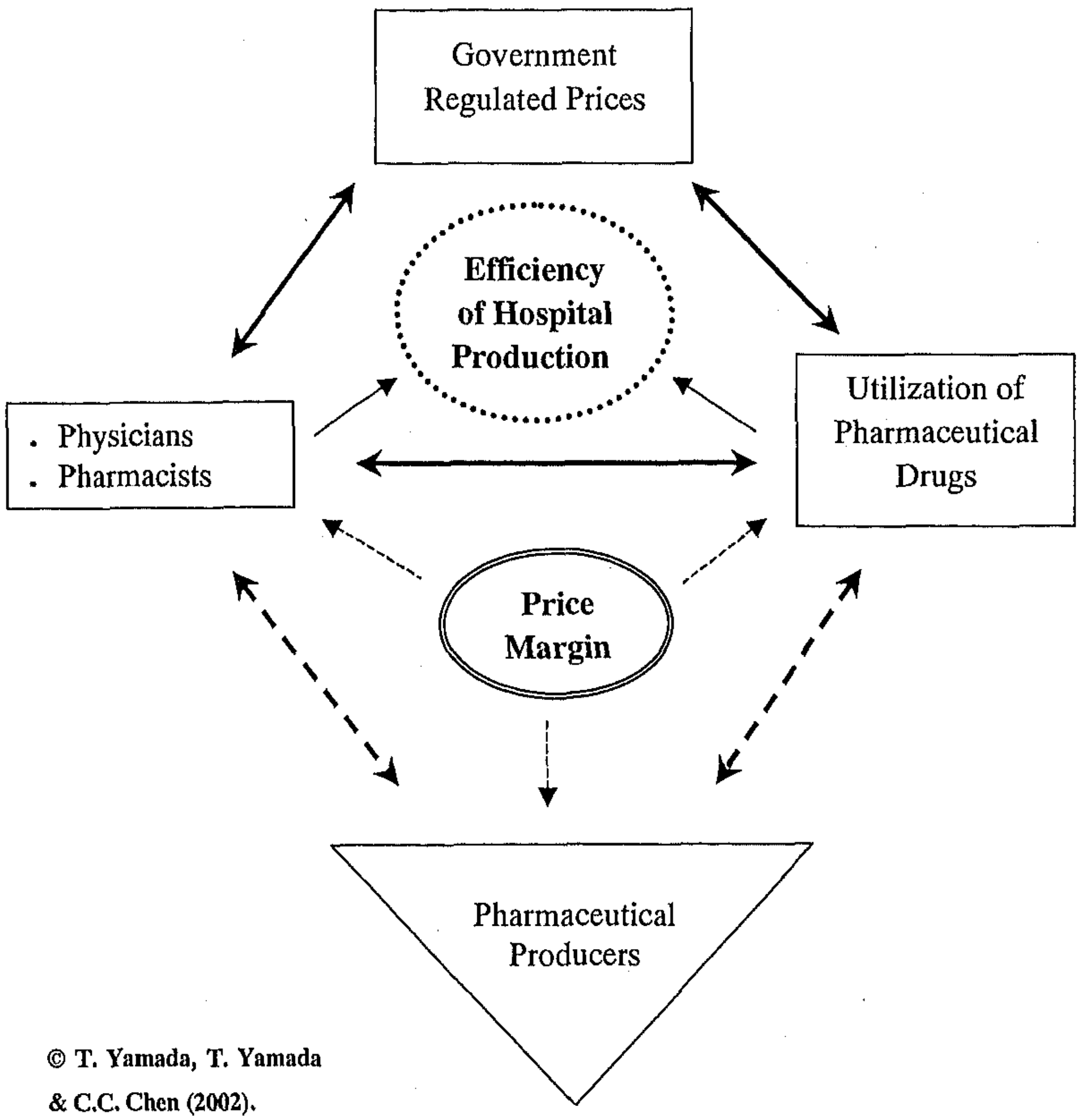

Figure 2. Efficiency Diagnosis of Hospital Production

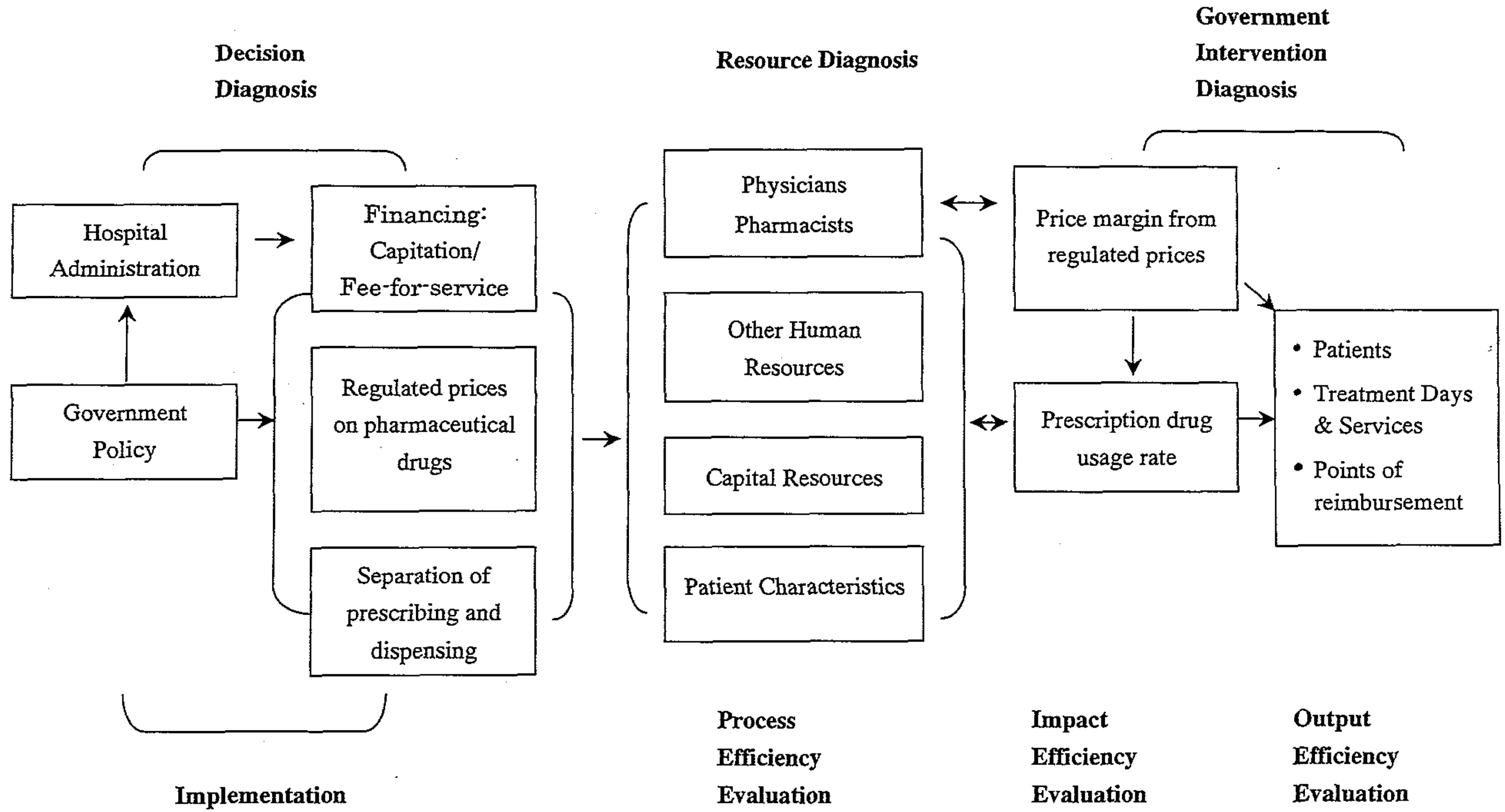

Table 1. Regulated Price Reduction Rate (RP) and Medication & Injection (M&I) Points Per Episode of Illness

		Hospital Services to Elderly*				Hospital Services to Non-elderly			
Year	RP %	Inpatient Total Points	(M&I) Inpatient Share (%)	Outpatient Total Points	(M&I) Outpatient Share (%)	Inpatient Total Points	(M&I) Inpatient Share (%)	Outpatient Total Points	(M&I) Outpatient Share (%)
1987	0	30,529.4	22.7	1,758.9	51.5	26,160.6	18.7	1,016.7	41.0
1988	-10.2	29,706.1	23.8	1,788.0	50.2	25,508.2	19.6	1,071.1	40.0
1989	+2.7	30,630.4	24.2	1,875.9	52.9	25,416.5	20.1	1,098.0	41.6
1990	–9.2	30,023.3	20.5	1,885.3	50.8	26,311.6	17.7	1,133.3	39.6
1991	0	30,578.1	20.5	1,990.9	52.4	27,015.6	17.5	1,199.3	40.8
1992	-8.1	32,713.0	17.7	1,926.3	51.6	29,556.2	16.6	1,186.2	41.4
1993	0	34,200.1	16.2	1,960.6	51.1	29,652.4	15.5	1,206.8	42.5
1994	-6.6	34,570.2	14.3	1,934.8	48.3	29,201.8	12.9	1,219.7	39.3
1995	0	32,554.7	15.7	2,059.4	48.8	32,282.4	14.6	1,275.8	39.2
1996	-6.8	33,994.3	16.0	2,053.6	46.7	29,716.1	13.8	1,288.8	38.4
1997	-4.4	35,335.6	15.6	2,042.1	44.7	30,769.9	14.2	1,263.0	36.6
1998	-9.7	35,113.1	13.6	1,944.4	39.3	30,446.8	12.1	1,290.8	32.9
1999	0	34,860.6	13.0	1,892.5	38.8	29,304.2	12.6	1,281.8	30.6
2000	-7.0	37,799.8	13.0	1,786.1	39.0	30,208.8	11.4	1,164.9	31.5

Notes:

(i) * means that an elderly person who is 70 years and over or who is 65-69 years old with an holder of Elderly Health Insurance because of physical condition under the National Health Insurance System.

(ii) One point is equal to 10 Japanese yen.

Sources:

Survey of Medical Treatments, Health Insurance Bureau, Ministry of Health, Labor and Welfare, 1993, 2000, 2002.

Journal of Health and Welfare Statistics, Ministry of Health, Labor and Welfare, Health, 2001.

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Table 2. General Hospital Production Estimation (2SLS)

	Outpatients		Inpatients	
Variable	Estimated Coefficient	t-statistic	Estimated Coefficient	t-statistic
Total Number of Prescriptions	0.034	9.096[a]	-0.015	-5.155[a]
Human Resources:				
Pharmacist	0.298	13.082[a]	-0.142	-6.823[a]
Physician	0.190	7.879[a]	0.028	1.489
Registered Nurse	-0.157	-9.787[a]	0.172	16.589[a]
Hospital size:				
General Beds	-0.805	-13.946[a]	0.873	25.173[a]
Geriatric Beds	-0.090	-10.154[a]	0.090	14.774[a]
Area of Inpatient Ward	-0.082	-3.694[a]	0.099	6.532[a]
In-patients	0.396	5.604[a]	----	----
Outpatients	----	----	0.379	7.890[a]
Intercept	5.980	44.359[a]	-2.881	-10.047[a]
Sample Size (N)	6,651		6,651	
Adjusted R-squared	0.6157		0.7749	
Standard. Error of Regression	0.7214		0.4980	

Notes:
(i) Variables are in logarithms.
(ii) a, b, and c indicate that the estimated coefficients are statistically significant at the 1%, 5% and 10%, respectively.
(iii) Other variables are omitted for purpose of concise discussion.
(iv) The source is based on IHEP "Report: Shizen Zou ni Kansuru Kenkyu" Tables 7-33-2 and –5 in p.305-309, 1998, Tokyo.

Table 3-1. Effect of Prescription, Treatment Days and Units of Service on Accumulated Points

	Prescriptions		Treatment Days		Units of Service	
	est. coeff.	t-stat.	est. coeff.	t-stat.	est. coeff.	t-stat.
General Hospitals	-0.94	-3.418[a]	1042.48	77.526[a]	621.27	93.902[a]
Specially Accredited Hospitals *with* the Capitation	15.52	0.425	1009.05	81.054[a]	267.98	33.470[a]
Specially Accredited Hospitals *without* the Capitation	123.65	2.778[a]	607.95	41.169[a]	337.83	35.658[a]

Notes:
(i) These results are for elderly patients, aged 65 and over.
(ii) Coefficients are marginal effects.
(iii) a, b, and c indicate that the estimated coefficients are statistically significant at the 1%, 5% and 10%, respectively.
(iv) Other variables are omitted for purpose of concise discussion.
(v) The source is based on IHEP "Report: Shizen Zou ni Kansuru Kenkyu" Tables 7-37-1, 7-40-1 and 7-39-1 in pp.332, 340 and 338, 1998, Tokyo.

Table 3-2. Effect of Regulated Drug Price on Treatment Days and Units of Service

	All Illness		Cancer		Heart-related illness		Mental Illness	
	Treatment Days	Units of Service	Treatment Days	Units of Service	Treatment Days	Units of Service	Treatment Days	Units of Service
Regulated Prices	-11.15	-9.27	-5.96	-1.28	-7.19	-2.98	3.15	3.64
	(-1.05)	(5.77a)	(-2.09b)	(-1.10)	(-2.56b)	(-1.81c)	(3.52a)	(2.70b)
Treatment Days	---	-0.1	---	-0.29	---	-0.46	---	-1.34
		(-2.37b)		(-4.99a)		(-5.18a)		(-10.43a)
Units of Service	-1.96	---	-2.22	---	-1.13	---	-0.69	
	(-2.49b)		(-9.94a)		(-4.26a)		(-10.68a)	

Notes:
(i) These results are for elderly patients, aged 65 and over.
(ii) Variables are in logarithms.
(iii) a, b, and c indicate that the estimated coefficients are statistically significant at the 1%, 5% and 10%, respectively.
(iv) Other variables are omitted for purpose of concise discussion.
(v) Source: Effectiveness of Government Policy (NBER Working Paper no. 4786), Yamada et al., 1994.

Table 4. Estimation of the Choice of Capitation for Specially Accredited Hospitals (logit model)

Variable	Estimated Coefficient	Marginal Effect	t-statistic
Total Number of Prescriptions	0.041	0.006	0.624
Human Resources:			
Pharmacist	-1.183	-0.179	-3.978a
Physician	-0.762	-0.115	-1.663c
Registered Nurse	1.313	0.199	5.841a
Hospital size:			
General Beds	0.307	0.046	0.921
Geriatric Beds	-0.234	-0.035	-1.564
Area of Inpatient Ward	-0.695	-0.105	-2.240b
Inpatient	-1.494	-0.227	-3.090a
Outpatient	0.171	0.026	1.479
Intercept	2.043	0.310	1.085
Sample Size (N)	546		
R-squared	0.374		
Log likelihood	-253.728		

Notes:
(i) a, b, and c indicate that the estimated coefficients are statistically significant at the 1%, 5% and 10%, respectively.
(ii) Independent variables are in logarithms.
(iii) Other variables are omitted for purpose of concise discussion.
(iv) The source is based on IHEP "Report: Shizen Zou ni Kansuru Kenkyu" Tables 7-34-5 in pp.316-317, 1998, Tokyo.

Table 5. Specially Accredited Hospital Frontier Production Function

	Outpatients		Inpatients	
Variable	Estimated Coefficient	t-statistic	Estimated Coefficient	t-statistic
Total Number of Prescriptions	0.016	0.562	-0.007	-1.282
Human Resources:				
Pharmacist	0.285	2.176[b]	-0.021	-0.865
Physician	0.340	2.232[b]	0.043	1.558
Registered Nurse	0.019	0.161	0.101	4.382[a]
Hospital size:				
General Beds	-0.619	-2.343[b]	0.478	12.273[a]
Geriatric Beds	0.058	0.751	0.008	0.448
Area of Inpatient Ward	0.265	1.777[c]	0.084	2.608[a]
In-patients	-0.392	-1.286	----	----
Outpatients	----	----	-0.004	-0.320
Intercept	5.542	6.070[a]	0.703	3.121[a]
Sample Size (N)	335		335	
Log Likelihood	-358.890		161.635	

Notes:

(i) Variables are in logarithms.

(ii) a, b, and c indicate that the estimated coefficients are statistically significant at the 1%, 5% and 10%, respectively.

(iii) Other variables are omitted for purpose of concise discussion.

(iv) The source is based on pp.34-35 of Discussion Paper #826, "Technical Efficiency of Production in Hospitals in Japan," 1999, University of Tsukuba, by Tadashi Yamada, Tetsuji Yamada, Seiritsu Ogura and Reiko Suzuki.

Table 6. Efficiency Estimation of Hospitals with Fee-For-Service and the Capitation

	Outpatients	Inpatients
General Hospitals (FFS)		
Technical Efficiency	0.521	0.639
LAMBDA	3.593	14.63
SIGI	0.967	1.571
Specially Accredited Hospitals (Capitation)		
Technical Efficiency	0.455	0.856
LAMBDA	7.316	-2.18
SIGI	0.774	4.48

Note: The results of Technical efficiency are based on a frontier production function by the model of Tables 2 and 5.